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Irrigation Management of Dry Beans

Beans belong to the legume family — as do alfalfa, clover, soybeans and a host of other plants. This family has characteristic flowers, pods, leaves and root nodules that produce free nitrogen. This nitrogen is an important source of plant food for future crops.

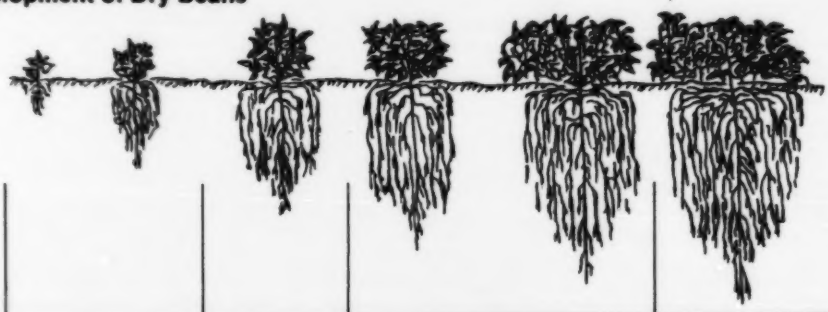
The field bean is a relative newcomer to southern Alberta. The potential of field beans as a cash and soil nutrient-building crop has been known for years, but the actual expansion of cultivated bean acreage was not realized until proper seed handling equipment was introduced.

Field beans are combine harvested as mature dry beans. They are used for human food and reach the grocery store in either canned or dry form.

Two basic plant types are found in dry edible beans: the determinate (bush) type, and the indeterminate (vining or trailing) type. Varieties are classified only according to plant types. There are many market classes of field beans. In each market class there are a number of varieties. However, the climatic conditions of southern Alberta limit the varietal selection to those with the required length of growing season. Three classes of interest are: the navy or pea bean; the Great Northern; and the colored types such as Red Mexcian and Pinto, which are somewhat larger. These latter types are preferred by the package trade.

Owing to its shallow rooting system, dry beans are highly sensitive to soil salinity. The crop does not tolerate soil salts at germination, seedling or the growth stage.

Growth and Development of Dry Beans



GROWTH PERIODS	VEGETATIVE	FLOWERING	POD FORMATION	RIPENING
POST EMERGENCE DATES	40 - 45 DAYS	50 - 60 DAYS	65 - 85 DAYS	105 - 110 DAYS
CROP * ROOT DEPTH	2cm/DAY		MINIMAL ROOT EXTENSION	
MOISTURE SENSITIVE PERIOD **				
AVERAGE E.T.	2.0 - 3.5mm/DAY	3.5 - 5.0mm/DAY	5.0 - 6.0mm/day	<6.0mm/DAY

* Maximum rooting depth will occur approximately by the time flowering begins.

** For optimum production, the first irrigation will be required before the crop enters into its water sensitive period.

The above times, depths and amounts are only average values for this particular crop. These values will change depending on the variety and area where this crop is grown.

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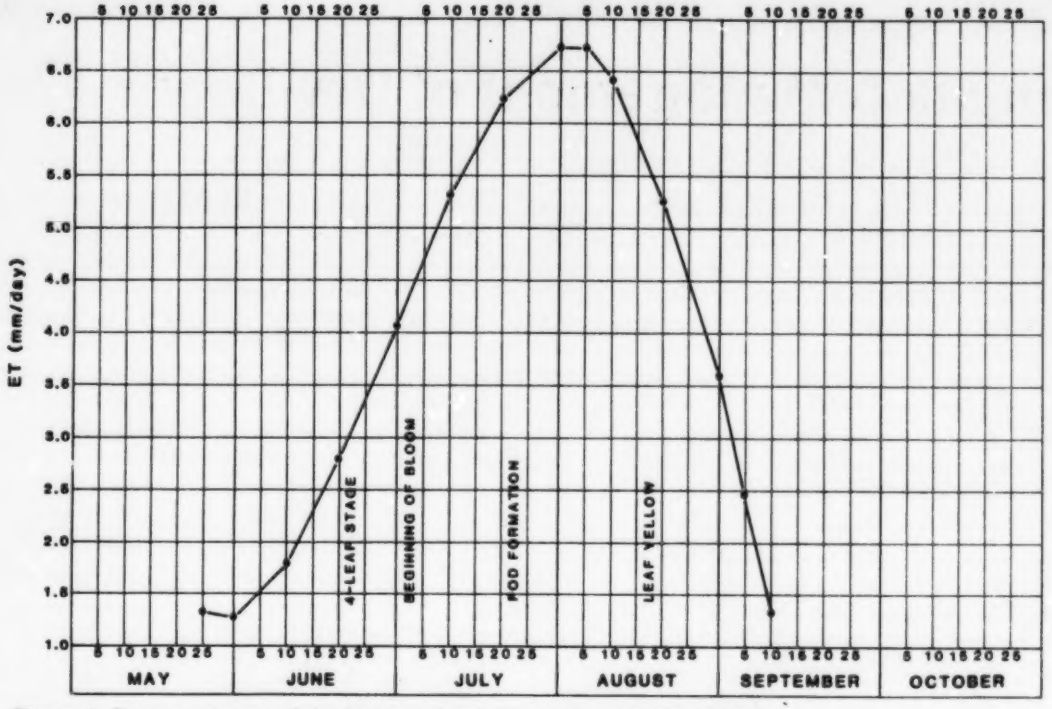

Figure 1. Crop water use of dry beans (pinto) during the growing season.

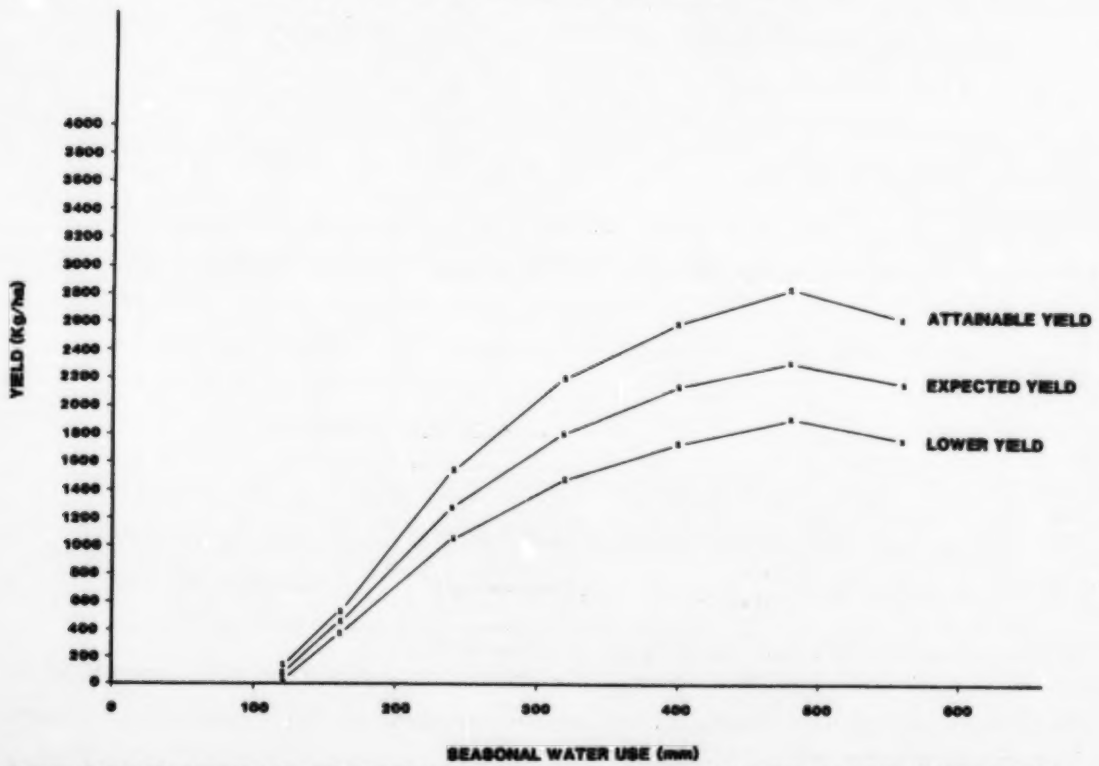

Figure 2. Graph showing the relationship between yield and seasonal water use in dry beans (pinto).

Optimum growth for dry beans occurs when the mean daily temperature ranges between 15 and 20°C. The minimum mean daily temperature for growth is 10°C, the maximum 27°C. High temperatures increase the fibre content in the pod. Dry beans require a minimum soil temperature of 8-10°C before germination will occur.

Crop water requirements and crop yields

The seeding date for this crop is generally between May 20 and June 1 and the growth period from May 25 to September 5 (allowing 100 to 105 days to maturity). Seasonal moisture use will approach 380 mm (15 in.) with a 30 day period maximum of 5.5 mm/day (0.22 in./day). The critical water use period for dry beans is from flowering to pod setting. Water use during this period may be as high as 6.5 mm/day (0.26 in./day).

The bean root may penetrate over 1.0 m into the soil, but for irrigation purposes a root zone of 90 cm should be sufficient. Peak moisture use generally occurs 6 to 12 weeks after emergence when roots are mainly in the first 60 cm of the root zone (flowering period). It is essential to maintain adequate moisture by using 40 per cent as the allowable depletion level. Eighty per cent of the required water is drawn from the top 60 cm of the root zone.

Dry beans are successfully grown on a wide variety of soil types, ranging from light sandy to heavy clay loams. The lighter soils usually produce an early crop whereas the heavier soils produce a later crop. Beans thrive best on deep well-drained soils.

The uniformity of land slope encouraging good drainge and preventing ponding when irrigating is important for good dry bean production. Bean plants are very susceptible to root rot and disease when soil conditions remain wet for any length of time. Beans will not survive if left standing in water for any length of time.

Dry beans can withstand considerable moisture stress without major yield reductions. Visible stress symptoms, such as shown by leaf color change, will reduce vegetative growth but not seed yield. The critical water requirement period is from the time just prior to flowering to the time pods begin to change color (See figure 1). A stress period longer than five days during flowering reduces both the number of pods and beans per pod. Stress during maturing reduces bean weight. The bean root system is sparse compared to many other crops, hence, irrigation may be necessary at relatively frequent intervals even though the crop is not especially sensitive to moisture stress.

The dry bean crop has rather rigid irrigation requirements during the growing season. Assuming a moist seed bed is available permitting normal germination, then at least one thorough irrigation will be necessary prior to blooming. Irrigation should not be carried out during the period of full bloom, since any interruption in the growth pattern can cause the blossoms to drop. After blooming is completed, a further medium irrigation (beans being only moderately deep-rooted) may be necessary to stimulate active and uniform pod and seed development.

A good commercial yield of dry beans under irrigation is 1600 kg/ha (1800 lb/ac). Research yields of 3500 kg/ha (3900 lb/ac) have been attained. (See figure 2)

Comments

Spring seed bed preparation can begin with a fall irrigation followed by deep cultivation, leaving the land rough. The aim of land preparation for beans is to assist in the emergence of the young bean seedling. Since their emergence is hindered by compacted or crusted soil, a relatively loose, moist soil is required above the seed.

With some varieties irrigating too frequently reduces yield. Very wet soil during the seedling stage of growth encourages root diseases. Similarly, after vegetative growth is well advanced, a wet soil surface may increase the incidence of organisms that attack aboveground plant parts. Wet conditions at harvesting delay harvesting operations. The last irrigation should occur early enough that the crop will extract most of the water from the top half of the root zone before undercutting time. A dry surface will make it easier to cut and combine the beans and will prevent pods from rotting or the seed from becoming discolored.

The proper choice of inoculant and method of inoculation are important when growing the dry beans.

Irrigation management information

For further information regarding irrigation management of dry beans, contact your nearest irrigation branch office. Location of these offices is Lethbridge, 381-5136; Vauxhall, 654-2161; Airdrie, 948-8511; Taber, 223-7908; Strathmore, 934-3356; Brooks, 362-1212; Bow Island, 545-2231; Medicine Hat, 529-3616. North of Calgary, contact the Airdrie office or your local district agriculturist for assistance.

Conversion factor:

1 kg/ha = 0.89 lb/ac
1 lb/ac = 1.12 kg/ha

Soil

Soils can vary greatly in texture from being very fine (clay) to very coarse (sand) within a crop root zone. Because soil texture can change quite quickly so can the amount of water that the soil is able to hold.

Texture	Available Moisture
Loamy sand	8-12 mm/0.1m (0.9-1.4 in./ft)
Sand loam	10-15 mm/0.1m (1.2-1.8 in./ft)
Loam	14-18 mm/0.1m (1.7-2.1 in./ft)
Sand clay loam, clay loam, clay	15-20 mm/0.1m (1.8-2.4 in./ft)
Silty clay loam, silt loam	16-22 mm/0.1m (1.9-2.6 in./ft)

It is important to know and to be able to calculate the amount of moisture present in the soil root zone in order to understand the amount of moisture available for crop use. Allowable depletion level is the amount of soil mositure that can safely be removed from the root zone by a crop before an irrigation is required. For Dry Beans, the allowable depletion level has been determined to be 40%. The simplest way to determine soil moisture content is by the "feel" method. By feeling, squeezing and observing a handful of soil, one can determine the amount of moisture present in the soil. The following chart outlines the various characteristics of soil based on differing water contents.

		Feel or Appearance of Soils		
	PERCENT OF AVAILABLE MOISTURE REMAINING	MODERATELY COARSE TEXTURE	MEDIUM TEXTURE	MODERATELY FINE TEXTURE
DO NOT IRRIGATE	At field capacity 100	Upon squeezing no free water appears on soil but wet outline of ball is on left hand.	Same as sandy loam.	Same as sandy loam.
	75 to field capacity	Forms a weak ball, breaks easily, will not slide.	Forms a ball and is very pliable; slicks readily if relatively high in clay.	Easily ribbons out between fingers,has a slick feeling.
IRRIGATE SPEC. CROPS	50 to 75	Tends to ball under pressure but seldom will hold together	Forms a ball; somewhat plastic; will sometimes slick slightly with pressure.	Forms a ball, will ribbon out between thumb and forefinger.
IRRIGATE	25 to 50	Still appears to be dry, wil not form ball with pressure.*	Somewhat crumbly but will hold together from pressure.	Somewhat pliable, will ball under pressure.
	0 to 25	Dry, loose, single-grained, flows through fingers.	Powdery, dry, sometimes slightly crusted but easily breaks down into powdery condition.	Hard, baked, cracked; sometimes has loose crumbs on surface.

* Ball is formed by squeezing a handful of soil firmly